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THE ZONED 1440 AD ERUPTION OF THE SOUFRIERE OF GUADELOUPE (LESSER ANTILLES): AN EXPERIMENTAL DETERMINATION OF THE PRE-ERUPTIVE CONDITIONS OF THE ANDESITIC MAGMA BODY

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The 1440 AD eruption of the Soufriere of Guadeloupe (Lesser Antilles arc) is characterized by a dramatic change of the chemical composition of erupted products, from andesitic (clear pumices, 61-62 wt% SiO2) to basaltic andesite (dark scoria, 55-56 wt% SiO2). This compositional sequence is interpreted to reflect the tapping of a silicic magma body remobilised following the arrival of a mafic magma batch. The conditions of equilibrium (T, P, fO2, melt H2O content) within the andesite body prior to the mixing event were determined from a coupled mineralogical/petrological and experimental approach.

The andesitic pumices comprise plagioclase, orthopyroxene, clinopyroxene, magnetite and rare ilmenite phenocrysts. Plagioclase shows complex oscillatory zoning (An55-75), with rim compositions close to An65. Orthopyroxene (En55-60) and magnetite (Mt65-70) are weakly zoned. Glass inclusions trapped in plagioclase and orthopyroxene are rhyolitic (72 wt% SiO2). They show small variations in water contents from 4.5 to 5.5 wt%, as determined with the by-difference technique and from near-infrared spectroscopy. Pairs of coexisting Fe-Ti oxides yield equilibrium temperatures ranging between 800°C and 950°C for DNNO values between +0.4 and +1 (calculations at 2 kbar).

A sample representative of the andesitic body (61 wt% SiO2) was selected for the experiments. All were performed in an internally heated pressure vessel equiped with a fast quench apparatus, at T between 800 and 950°C, P between 1 and 2 kbars,

fO2 from DNNO-1 to DNNO+2, and for both water saturated and undersaturated conditions, using H2O-CO2 mixtures. Comparison between experimental and natural phase assemblage and chemical compositions allows the equilibrium conditions of the andesitic body to be specified, i.e. 875-900°C, 1.5 ś 0.25 kbar, DNNO = +0.5 to +1 and melt H2O content between 4.5 to 5 wt%.